DOCUMENT RESUME

ED 148 585 SE 023 410

AUTHOR Gearheart, Robert A.; And Others
TITLE Advanced Waste Treatment, Wastewater Technology: A Two-Year Post High School Instructional Program. An Instructor's Guide for Use of Instructional Material in Wastewater Technology Training Programs. Volume VI.
INSTITUTION Charles County Community Coll., La Plata, Md.; Clemson Univ., S.C.; Greenville Technical Coll., S.C.; Linn-Benton Community Coll., Albany, Oreg.
SPONS AGENCY Environmental Protection Agency, Washington, D.C. Municipal Permits and Operations Div.
PUB DATE Nov 76
NOTE 26p.; For related documents, see SE 023 407-409 and SE 023 432

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Behavioral Objectives; Curriculum; Educational Programs; Environment; *Environmental Technicians; *Instructional Materials; *Pollution; *Post Secondary Education; *Water Pollution Control
IDENTIFIERS *Waste Water Treatment

ABSTRACT

This document is one in a series which outlines performance objectives and instructional modules for a course of study which explains the relationship and functions of the process units in a wastewater treatment plant. The modules are arranged in order appropriate for teaching students with no experience. The modules can also be rearranged and adapted for courses to upgrade personnel moving into supervisory positions or designed as a minicourse. Each module contains a statement of purpose, objectives, conditions, acceptable performance, instructor and student activity. The tasks are organized into the general categories of: normal operation, abnormal operation, preventive maintenance, corrective maintenance, laboratory control, systems interaction, and management/supervisory procedures. This volume includes six modules: (1) Function of Water Treatment Processes; (2) Principal Water Treatment Operational Characteristics; (3) Function of Advanced Wastewater Treatment Processes; (4) Principal Advanced Wastewater Treatment Operational Characteristics; (5) Removal Efficiencies; and (6) Comparison of Treatment Processes. (CS)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED148585

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Bernard Lukco

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

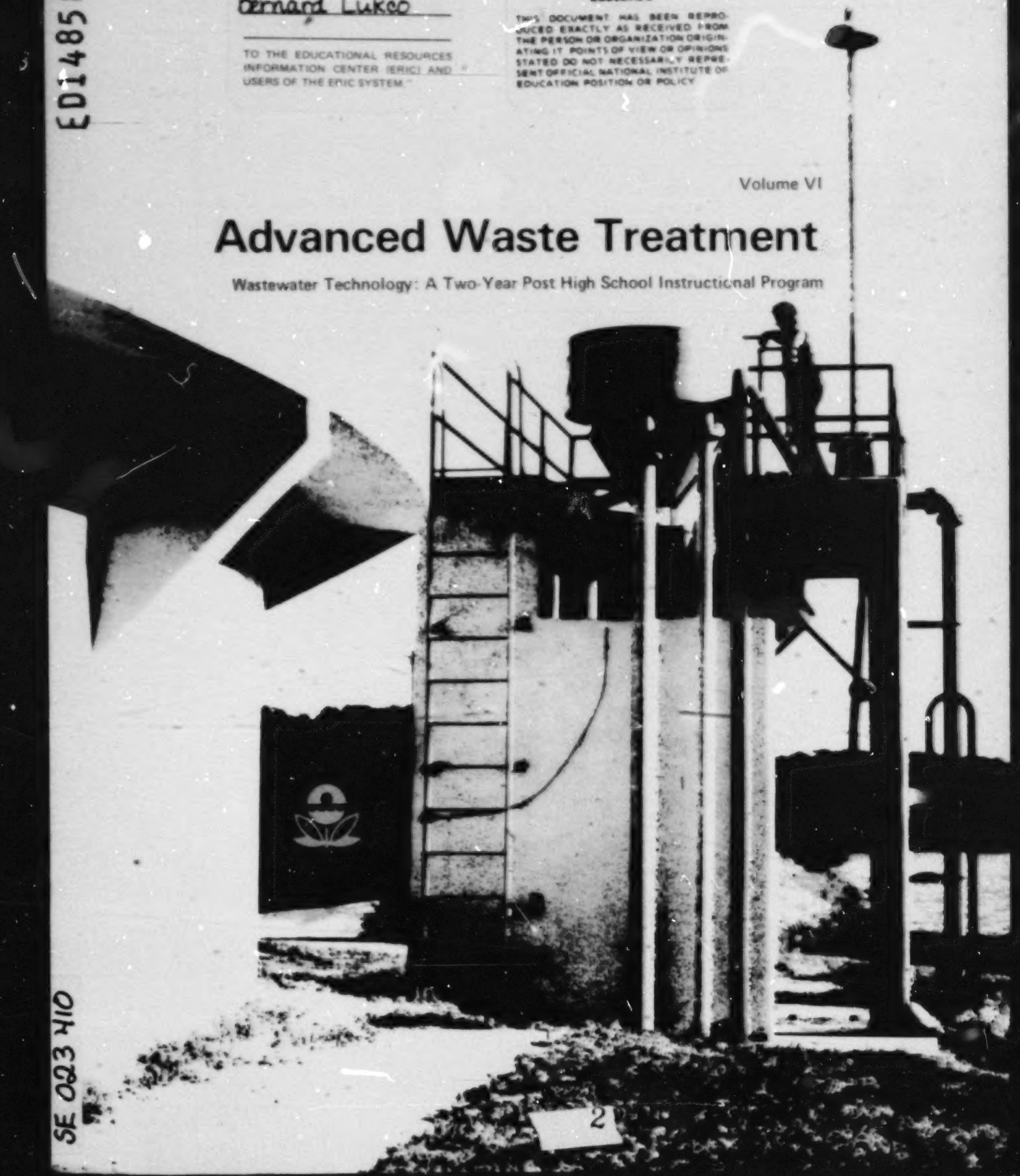
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Volume VI

Advanced Waste Treatment

Wastewater Technology: A Two-Year Post High School Instructional Program



SE 023 410

ADVANCED WASTE TREATMENT

An Instructor's Guide for Use of Instructional Material
In Wastewater Technology Training Programs

Funded by

US ENVIRONMENTAL PROTECTION AGENCY
Municipal Permits & Operations Division
Water Quality Control Manpower Training Branch
Academic Training Section

Awarded to

CHARLES COUNTY COMMUNITY COLLEGE
La Plata, Maryland

GREENVILLE TECHNICAL COLLEGE
Greenville, South Carolina

LINN-BENTON COMMUNITY COLLEGE
Albany, Oregon

ENVIRONMENTAL SYSTEMS ENGINEERING
Clemson University
Clemson, South Carolina

November 1976

For Information

ON FUNDING OF INSTRUCTIONAL PROGRAMS

Manpower, Planning and Training Branch
MOTD/OWPO
US Environmental Protection Agency
Washington, DC 20460
202-426-7887

ON PROJECT ADMINISTRATION AND CURRICULA DEVELOPMENT

John H. Austin, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
803-656-3276

ON PROGRAM IMPLEMENTATION

Carl Schwing
Charles County Community College
La Plata, Maryland 20646
301-934-2251

James L. Chocklett
Greenville Technical College
Greenville, South Carolina 29606
803-242-3170

Peter C. Scott
Linn-Benton Community College
Albany, Oregon 97321
503-928-2361

Preface

Since 1970 Charles County Community College, Clemson University, Greenville Technical College and Linn-Benton Community College have been working together to prepare undergraduate students to enter occupations in water and wastewater treatment plant operations and maintenance. Through their efforts a two-year wastewater technology instructional program based on performance objectives has been developed and implemented.

Through a grant from the Environmental Protection Agency called *Criteria for the Establishment of Two-Year Post High School Wastewater Technology Programs (CEWT)* the four colleges set up program criteria and curriculum guidelines which are available in two volumes:

Program Implementation Procedures
Curriculum Guidelines, Criteria for Establishment and Maintenance of Two-Year Post High School Wastewater Technology Programs

As a result of the implementation of the instructional program at Charles County Community College, Greenville Technical College and Linn-Benton Community College, six guides for instructors based on the course descriptions in *Program Implementation Procedures* and the general criterion behaviors of *Curriculum Guidelines* have been prepared. *Advanced Waste Treatment* is the sixth in the series which includes:

Volume I *Introduction to Environmental Technology*
Volume II *Plant Operations for Wastewater Facilities*
Volume III *Laboratory Control for Wastewater Facilities*
Volume IV *Management and Supervision Procedures for Wastewater Facilities*
Volume V *Process Interaction for Wastewater Facilities*
Volume VI *Advanced Waste Treatment*

ACKNOWLEDGEMENTS

Since the beginning of the project many persons at the four cooperating institutions, as well as outside consultants have participated in the development of this program. Their efforts which have provided source material for this guide have been acknowledged in the volumes to which they made major contributions. *Advanced Waste Treatment* has been written and produced by:

Technical Staff

Robert A. Gearheart, Professor, Humboldt State University, Arcata, California

Fred L. Delvecchio, Director of Operator Training, Environmental Systems Engineering, Clemson University
John H. Austin, Professor and Head, Environmental Systems Engineering, Clemson University

Editorial and Production Staff

Ada Louise Steirer, Freelance Editor, Clemson, South Carolina
Marie N. Sims, Project Secretary, Engironmental Systems Engineering, Clemson University
Charlotte Holmes, Typing Services, Clemson, South Carolina

Table of Contents

Page

PREFACE iii

PERFORMANCE OBJECTIVES. 1

INTRODUCTION TO MODULES OF INSTRUCTION. 3

GLOSSARY OF VERBS 7

MODULES OF INSTRUCTION

Module 1 Function of Water Treatment Processes 9

Module 2 Principal Water Treatment Operational Characteristics 11

Module 3 Function of Advanced Wastewater Treatment Processes 13

Module 4 Principal Advanced Wastewater Treatment Operational Characteristics 15

Module 5 Removal Efficiencies. 17

Module 6 Comparison of Treatment Processes 19

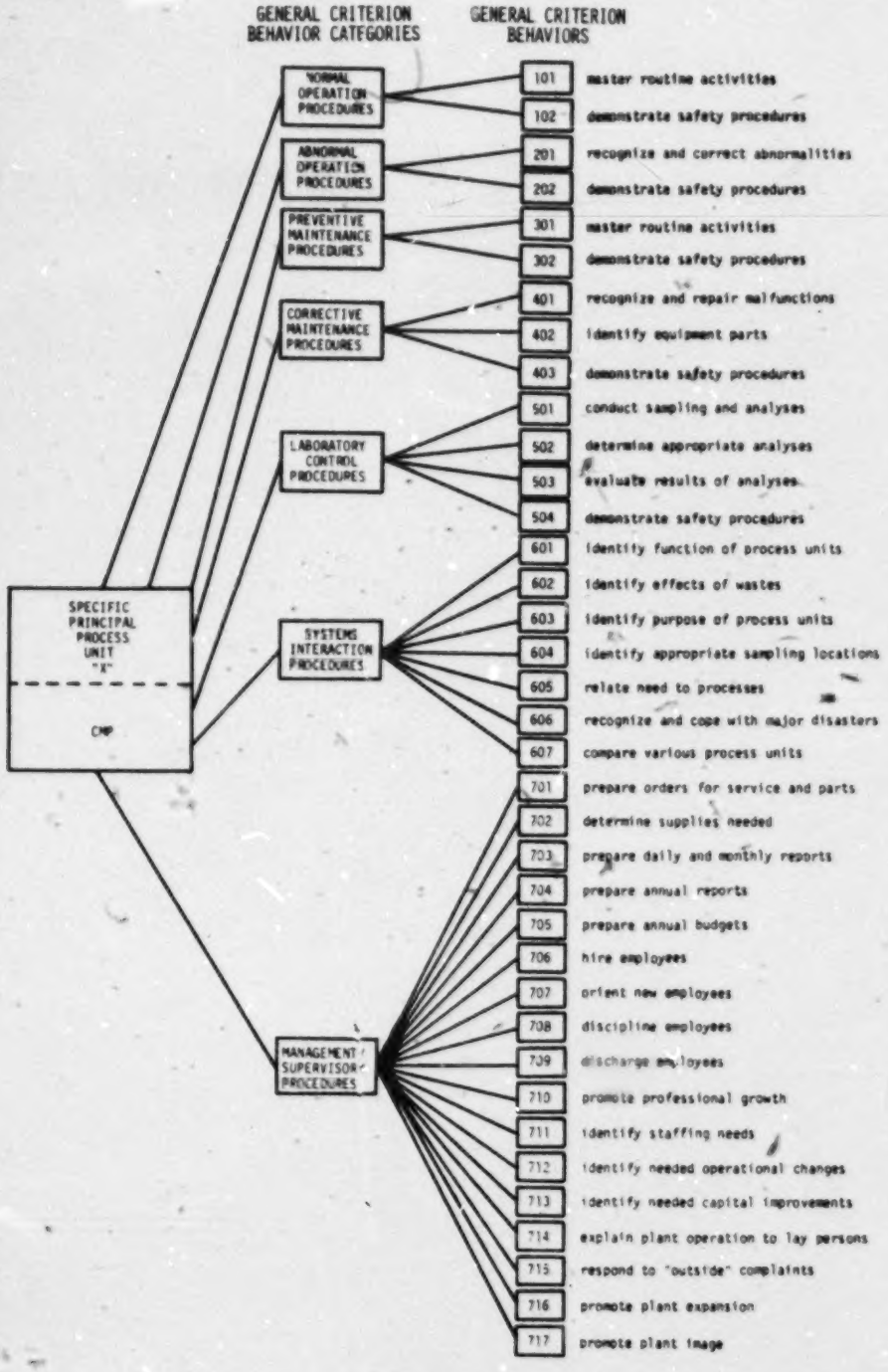

GENERAL CRITERION BEHAVIOR CATEGORIES
GENERAL CRITERION BEHAVIORS
NORMAL OPERATION PROCEDURES
ABNORMAL OPERATION PROCEDURES
PREVENTIVE MAINTENANCE PROCEDURES
CORRECTIVE MAINTENANCE PROCEDURES
LABORATORY CONTROL PROCEDURES
SYSTEMS INTERACTION PROCEDURES
MANAGEMENT/ SUPERVISORY PROCEDURES
SPECIFIC PRINCIPAL PROCESS UNIT "X"
CMP
101 master routine activities
102 demonstrate safety procedures
201 recognize and correct abnormalities
202 demonstrate safety procedures
301 master routine activities
302 demonstrate safety procedures
401 recognize and repair malfunctions
402 identify equipment parts
403 demonstrate safety procedures
501 conduct sampling and analyses
502 determine appropriate analyses
503 evaluate results of analyses
504 demonstrate safety procedures
601 identify function of process units
602 identify effects of wastes
603 identify purpose of process units
604 identify appropriate sampling locations
605 relate need to processes
606 recognize and cope with major disasters
607 compare various process units
701 prepare orders for service and parts
702 determine supplies needed
703 prepare daily and monthly reports
704 prepare annual reports
705 prepare annual budgets
706 hire employees
707 orient new employees
708 discipline employees
709 discharge employees
710 promote professional growth
711 identify staffing needs
712 identify needed operational changes
713 identify needed capital improvements
714 explain plant operation to lay persons
715 respond to "outside" complaints
716 promote plant expansion
717 promote plant image

Figure 1: Relationship of general criterion behaviors (performance objectives) to the general categories and composite model plant (CMP).

Performance Objectives

When the treatment plant operators, educators, consultants and representatives from professional water pollution control organizations came together to develop an effective instructional program, they recommended the use of performance or behavioral objectives because such objectives clearly outline:

1. What the student is expected to do as a result of the instructional program.
2. The conditions under which the student shall do it.
3. The standard of performance.

COMPOSITE MODEL PLANT

First, they developed a composite model plant (CMP) of twenty-two process units which is really many wastewater treatment plants in one model. Such a mix of process units seldom occurs in a treatment plant, but if a student becomes competent in the operation and management of the CMP he should be able to perform successfully in any treatment plant.

TASK ANALYSIS

Next, to ensure that the materials were specifically tailored to what the operator does on the job, a task analysis was conducted. They found that the tasks which an operator performs fell into seven general categories which were further divided into 37 tasks or general behaviors. (See figure 1, page vi.) The tasks were organized under:

1. Normal Operation Procedures. These include routine operating activities that do not vary significantly from day to day and that are designed to keep the plant functioning within a normal range of values. For example, the employee conducts routine samplings of the primary sludge and inspects pumping equipment and the wastestream to verify that the process is functioning properly.

2. Abnormal Operation Procedures. These include activities of the plant employee that result from unusual and undesirable conditions of the wastestream. The abnormal procedures enable the plant employee to recognize when the wastestream is abnormal and to return it to an acceptable, normal condition. An abnormal wastestream results when a normal operation procedure is not properly applied, a corrective maintenance procedure is needed or management/supervisory procedures are poor. For example, the plant employee should recognize that a black septic primary sludge sample is an abnormal condition of the wastestream and take appropriate action.

3. Preventive Maintenance Procedures. These include routine maintenance activities of the plant employee which prevent major equipment breakdown and subsequent corrective maintenance. For example, the employee would lubricate bearings and other moving parts, replace worn components and adjust components of the primary sludge pumps.

4. Corrective Maintenance Procedures. These include maintenance activities of the plant employee that usually result from the breakdown or malfunction of a unit of equipment or a component. For example, the employee would notice whether the primary sludge pump is malfunctioning and know when and how to correct the disorder or when and how to refer the problem to plant maintenance personnel.

5. Laboratory Control Procedures. These include special and routine activities relating to laboratory analysis, the specification of sampling procedures and locations and the general management of the laboratory facilities. For example, the employee would collect primary sludge samples and conduct the analyses.

6. Systems Interaction Procedures. These include activities of the plant employee which relate the functioning of specific units of equipment to other process units and to the system as a whole. For example, the employee would determine how the effective functioning of the primary sludge pumps relates to digester performance.

7. Management/Supervisory Procedures These include activities relating to employment practices, record keeping, plant operation policy and the establishment of a constructive and realistic rapport between the plant and the community it serves. For example, the employee would keep records on primary sludge pumping, keep an inventory of spare parts and evaluate the adequacy of maintenance procedures by shift personnel.

CURRICULUM DESIGN

After deciding what process equipment an operator must operate and maintain, and finding out what an operator does through the task analysis, they listed the objectives a student must master to successfully operate and manage a treatment plant. For example, the student will describe and perform the normal inspection procedure for the primary sedimentation unit including frequency of inspection, conditions to look for and the actions he should take.

INSTRUCTOR'S GUIDES

The next step was the design of manuals to guide the instructor. In the guides varied learning activities and imaginative innovations which produce more learning than traditional teaching methods are emphasized. The instructional suggestions do not need to be followed slavishly, but should be modified and improved as much as possible.

The instructor's goal is to achieve the objectives of the curriculum by selecting activities which suit the student's needs and help him to master all the information and skills in the course. The most effective learning occurs when the student is a participant in the learning process, not a spectator.

An instructor should use learning activities which approximate the situations which the student will meet *in the treatment plant*. If it is not possible to teach in a treatment plant, *simulated situations* should be set up in the workshop or classroom so that the student can solve rather than discuss problems. *Group discussion* stimulated by *visual materials* is an effective learning technique. Lecturing, however, is inefficient. Because the student is not actively involved during a lecture, the instructor should use lectures sparingly.

Introduction to Modules of Instruction

In this instructor's guide the topics and ideas are presented as a series of modules, organized around the general objectives stated in the course description for Advanced Waste Treatment found in *Program Implementation Procedures* of the *CEWT Program*. The modules are designed to help the instructor plan a course of study for the operator of a water treatment plant or wastewater treatment plant with advanced waste treatment processes.

The modules in *Advanced Waste Treatment* are for students who have completed prerequisite material in *Process Interaction for Wastewater Facilities*. However, the modules can be adapted for courses which upgrade personnel in plant operations and technical supervision. The material in these modules is introductory. Neither detailed operational procedures nor theoretical aspects of advanced waste treatment are included.

INSTRUCTIONAL SETTING

During training the student should have access to a water treatment plant and as many of the advanced waste treatment process units as possible.

PURPOSE OF THE MODULES

The modules in *Advanced Waste Treatment* stress the similarities and differences between water and wastewater treatment processes. They acquaint the student with the more advanced treatment processes for producing a high quality effluent.

STUDENT PREREQUISITES

Completion of Introduction to Environmental Technology, Plant Operations and In-Plant Practicum, Laboratory Control and Process Interaction qualify the student to enter Advanced Waste Treatment. Concurrent courses in Management and Supervision Procedures, Applied Economics and Politics and Applied Psychology and Human Relations are suggested. (See pages 7 to 19 of *Program Implementation Procedures*.)

TERMINAL OBJECTIVE

When the student has completed the modules of instruction in this course, he should be able to:

1. Describe the processes in a water treatment plant, prepare a flow diagram of the processes and explain the function of each process.
2. Describe how each water treatment process works in technical and nontechnical terms.
3. Describe the processes in an advanced wastewater treatment plant, prepare a flow diagram of the processes and explain the function of each process.
4. Describe how each advanced wastewater treatment process works in technical and nontechnical terms.

5. List the expected removal efficiencies and effluent concentrations for water and advanced wastewater treatment processes.

6. Describe the features of an advanced wastewater treatment unit which enable it to remove or alter a wastewater characteristic. Compare the water treatment processes and advanced wastewater treatment processes.

RESOURCES

The listing of instructional resources suggests materials now available to instructors to accomplish the desired performance in the student. The resource numbers referred to in the modules are keyed to *Water Quality Instructional Resources Information System (IRIS)* which is available from:

National Training Center
MOTD/OWPO
US Environmental Protection Agency
Cincinnati, OH 45268
513-684-7501

Suggestions for selecting audio-visual equipment can be found in *Selecting Audio-Visual Equipment* and *Selecting Instructional Media and Instructional Systems* available from:

Middle Atlantic Applied Technology Inst.
Charles County Community College
La Plata, MD 20646

If suitable materials are not available, instructors are urged to develop their own resources.

FORMAT OF THE MODULES

The module begins with a statement of purpose which explains what the student will be studying. Next, code numbers keyed to a computerized list of instructional resources are listed for the instructor's convenience.

Objectives. The objectives bring the student to the performance level required by the terminal objective. The instructor's evaluation of the student is based solely on what is stated in the objective.

A glossary of verbs which follows this introduction defines the verbs used in the objectives so that the instructor is aware of what he is instructing the student to do and so that his evaluation of the student is based solely on what is stated in the objective.

Conditions. The conditions define the circumstances under which the student performs and is evaluated and lists the information, equipment and assistance to which the student will have access. The best available learning and testing conditions should be used. For example, if the student is to be given a process unit or photographs of a unit, the instructor should provide a process unit. If a process unit is not available, the instructor should use components of the unit in combination with photographs of those components which he does not have available. Line drawings and diagrams should not be used if photographs and manufacturers' illustrations are available.

Acceptable Performance. The acceptable performance expands the objective and details the steps a student must follow to reach the objective. To move on to the next objective the student must score 70% on each step listed under acceptable performance. In this section the instructor will find the main topics of his lesson plan and for the evaluation of the student's performance.

Instructor Activity. The instructor should get to know his class by working with small groups and with each student. He should encourage students to learn from each other as they work together. He should involve the student in the instructional and learning

process. Group discussion and interaction should be emphasized. Films, filmstrips, slides, tapes, transparencies and case histories should be used. Instructional activities are paired numerically with student activities.

Student Activity. This is a listing of activities which the student will take part in, in order to accomplish the specified performance.

learning activities listed under instructor activity and student activity as evaluation techniques. The technique chosen should reflect what the objective asks the student to do. For example, if a student is asked to *describe*, the evaluation technique is a *description*. The student should be evaluated under the conditions and to the performance level required for each objective.

EVALUATION TECHNIQUE

The instructor may use or adapt the

Glossary of Verbs

The glossary of verbs is included here so that the instructor will know exactly what the student is being asked to do to meet his objective. The list includes all the verbs from the objectives and the acceptable performance sections of all the modules, as well as some verbs used in the instructor and student activities.

	DEFINITION	APPLICATION
CHECK	To inspect and ascertain the condition of, especially in order to determine that the condition is satisfactory.	Check the student's table of the effects of treatment processes on water characteristics and conditions.
COMPARE	To examine the character or qualities of, especially for the purpose of discovering resemblances or differences.	Compare the water treatment processes and advanced wastewater treatment processes.
DESCRIBE	To represent by words written or spoken for the knowledge or understanding of others; to transmit an image of the identifying features, the nature and characteristics of objects, events and actions.	Describe the function of the process unit.
DISCUSS	To talk about, to present in detail, to exchange views or information about.	Discuss the function of each process and why it is essential to the plant.
DISPLAY	To spread before the view.	Display visuals of the process units.
EXPLAIN	To make plain or clear; to present in detail.	Discuss the function of each process and explain why it is essential to the plant.
IDENTIFY	To establish the identity of, pick out or single out an object in response to its name by pointing, picking up, underlining, marking or other responses.	Identify the water treatment process units.

LIST	To enumerate or specify.	List the expected removal efficiencies.
LOCATE	To determine or indicate the place, site or limits of.	Select the references and locate the information needed.
OBSERVE	To pay careful, directed, analytical attention to.	Observe and describe the process units during a plant tour.
POINT OUT	To indicate the position or direction of, especially by extending a finger toward the thing so indicated; to direct someone's attention to.	Listen to the instructor as he points out each treatment process.
PREPARE	To make ready beforehand for some purpose.	Prepare flow diagrams of process units to meet given requirements.
PRESENT	To exhibit to view or notice; display.	Present a format for a table to compare the water treatment and advanced wastewater treatment processes.
SELECT	To choose something from a number or group usually by fitness, excellence, or other distinguishing feature.	Select the references and locate the information needed.

Module 1

FUNCTION OF WATER TREATMENT PROCESSES

PURPOSE: In this module the student will learn to describe the purpose of water treatment processes. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 6 8 460 469 857 886 1931 1998 2057

<<<<<<>>>>>>

OBJECTIVE 1.1: *Describe the processes in a water treatment plant, prepare a flow diagram of the processes and explain the function of each process.*

CONDITIONS: Given names, descriptions or pictures of the treatment units used during these processes:

aeration	adsorption
coagulation	chemical oxidation
flocculation	lime softening
mixing	ion exchange
sedimentation	iron and manganese removal
filtration	fluoridation
disinfection	distribution

ACCEPTABLE PERFORMANCE: The student will:

Identify the water treatment process units.

Describe the function of the process units.

Prepare flow diagrams of process units to meet given treatment requirements.

INSTRUCTOR ACTIVITY:

1. Display visuals of the process units in a water treatment plant and join them in a flow diagram.
2. Discuss the function of each process and explain why it is essential to the plant.
3. Take students on a field trip to a water treatment plant, point out each treatment process and explain the importance of each unit process.

4. After the field trip, require the student to prepare a notebook containing flow charts and diagrams of the treatment processes, a brief explanation of the function of each process unit and a list of principles used in the processes.

STUDENT ACTIVITY:

1. View visuals of the process units in a water treatment plant with other students and the instructor.
2. Discuss the function of each process and why it is essential to the plant with other students and the instructor.
3. Join in a field trip to a water treatment plant and listen to the instructor as he points out each treatment process and explains the importance of each unit process.
4. After the field trip, prepare a notebook containing flow charts and diagrams of the treatment processes, a brief explanation of the function of each process unit and a list of principles used in the processes.

<<<<<<>>>>>>

Module 2

PRINCIPAL WATER TREATMENT OPERATIONAL CHARCTERISTICS

PURPOSE: In this module the student will learn to explain the operational characteristics of each water treatment process. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 6 8 460 469 857 886 1931 1998 2057

<<<<<<>>>>>>

OBJECTIVE 2.1: *Describe how each water treatment process works in technical and nontechnical terms.*

CONDITIONS: Given names or pictures of the water treatment process units.

ACCEPTABLE PERFORMANCE: The student will:

Describe the process unit.

Describe how the process unit works.

Describe how the process unit affects water conditions and characteristics, including:

acidity	iron manganese
alkalinity	magnesium
ammonia nitrogen	nitrate nitrogen
calcium	nitrite nitrogen
chloride	odor
chlorine demand	orthophosphate
color	pH
conductivity	residual chlorine
dissolved oxygen	temperature
fecal coliform	total coliform
fluoride	total dissolved solids
flow	total phosphorus
gas (CO_2, CH_4, H_2S)	total solids
hardness	total suspended solids
heavy metals	turbidity
ice	

INSTRUCTOR ACTIVITY:

1. Describe the process units, using diagrams, photographs and slides.
2. Describe how each process unit works.
3. Describe the treatment processes during a plant tour. React to the student's descriptions of the processes.
4. Check the student's table of the effects of treatment processes on water characteristics and conditions.

STUDENT ACTIVITY:

1. Describe the process unit while viewing photographs, diagrams and slides.
2. Describe operational characteristics of the process units.
3. Observe and describe the process units during a plant tour.
4. Prepare a table indicating how each treatment process affects water characteristics.

<<<<<<>>>>>>

Module 3

FUNCTION OF ADVANCED WASTEWATER TREATMENT PROCESSES

PURPOSE: In this module the student will learn to describe the purpose of advanced wastewater treatment processes. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 838 857 886 1360 1662 2057

<<<<<<>>>>>>

OBJECTIVE 3.1: *Describe the processes in an advanced wastewater treatment plant, prepare a flow diagram of the processes and explain the function of each process.*

CONDITIONS: Given names, descriptions or pictures of the treatment units used during these processes:

- slow sand filtration
- intermittent sand filtration
- coagulation and precipitation
- ion exchange
- adsorption
- freezing
- evaporation
- microscreening
- flotation
- reverse osmosis
- electrodialysis
- pressure filtration
- ammonia stripping
- soil mantle application

ACCEPTABLE PERFORMANCE: The student will:

Identify the advanced wastewater treatment process units.

Describe the function of the process units.

Prepare flow diagrams of process units to meet given treatment requirements.

INSTRUCTOR ACTIVITY:

1. Display visuals of the process units in a wastewater treatment plant and join them in a flow diagram.
2. Discuss the function of each process and explain why it is essential to the plant.

3. Take students on a field trip to a wastewater treatment plant, point out each treatment process and explain the importance of each unit process.
4. After the field trip, require the student to prepare a notebook containing flow charts and diagrams of the treatment processes, a brief explanation of the function of each process unit and a list of principles used in the processes.

STUDENT ACTIVITY:

1. View visuals of the process units in a wastewater treatment plant with other students and the instructor.
2. Discuss the function of each process and why it is essential to the plant with other students and the instructor.
3. Join in a field trip to a wastewater treatment plant and listen to the instructor as he points out each treatment process and explains the importance of each unit process.
4. After the field trip, prepare a notebook containing flow charts and diagrams of the treatment processes, a brief explanation of the function of each process unit and a list of principles used in the processes.

<<<<<<>>>>>>

Module 4

PRINCIPAL ADVANCED WASTEWATER TREATMENT OPERATIONAL CHARACTERISTICS

PURPOSE: In this module the student will learn to explain the operational characteristics of each advanced wastewater treatment process. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 838 857 886 1260 1662 2057

<<<<<<>>>>>>

OBJECTIVE 4.1: *Describe how each advanced wastewater treatment process works in technical and nontechnical terms.*

CONDITIONS: Given names or pictures of the advanced wastewater treatment process units.

ACCEPTABLE PERFORMANCE: The student will:

Describe the process unit.

Describe how the process unit works.

Describe how the process unit affects wastewater conditions and characteristics, including:

- acidity
- alkalinity
- ammonia nitrogen
- BOD
- calorific value
- chloride
- chlorine demand
- COD
- color
- conductivity
- dissolved oxygen
- fecal coliform
- floating material
- flow
- foam
- gas (CO_2, CH_4, H_2S)
- grease
- grit composition
- ice
- industrial wastes
- Kjeldahl nitrogen
- level
- mean cell residence time
- nitrate nitrogen
- nitrite nitrogen
- odor
- oil
- orthophosphate
- pH
- relative stability

residual chlorine
settleable matter
septic sewage
sludge age
sludge density
sludge density index
sludge filterability
sludge volume index
temperature
total coliform
total dissolved solids
total phosphorus
total solids
total suspended solids
total volatile solids
toxic gases
turbidity
velocity
volatile acids
volatile solids

INSTRUCTOR ACTIVITY:

1. Describe the process units, using diagrams, photographs and slides.
2. Describe how each process unit works.
3. Describe the treatment processes during a plant tour. React to the student's descriptions of the processes.
4. Check the student's table of the effects of treatment processes on wastewater characteristics and conditions.

STUDENT ACTIVITY:

1. Describe the process units while viewing photographs, diagrams and slides.
2. Describe operational characteristics of the process units.
3. Observe and describe the process units during a plant tour.
4. Prepare a table indicating how each treatment process affects wastewater characteristics.

<<<<<<>>>>>>

Module 5

REMOVAL EFFICIENCIES

PURPOSE: In this module the student will learn the expected treatment efficiencies of water and advanced wastewater treatment processes. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 13 460 838 857 886 1260 1662 2057

<<<<<<>>>>>>

OBJECTIVE 5.1: *List the expected removal efficiencies and effluent concentrations for water and advanced wastewater treatment processes.*

CONDITIONS: Given references and a list of the water treatment and advanced wastewater treatment processes.

ACCEPTABLE PERFORMANCE: The student will:

Select the references.

List the expected removal efficiencies and effluent concentrations for each process.

INSTRUCTOR ACTIVITY:

1. Describe the references and how to use them.
2. Present a format for a table to tabulate removal efficiencies and effluent concentrations.

STUDENT ACTIVITY:

1. Select the references and locate the information needed.
2. Prepare tables with the information.

<<<<<<>>>>>>

Module 6

COMPARISON OF TREATMENT PROCESSES

PURPOSE: In this module the student will learn the features of advanced wastewater treatment systems which enable them to produce higher quality effluents than the process units in the composite model plant. READ PAGES 1 TO 8 BEFORE USING THIS MODULE.

RESOURCES: 13 460 838 857 886 1260 2057

<<<<<<>>>>>>

OBJECTIVE 6.1: *Describe the features of an advanced wastewater treatment unit which enable it to remove or alter a wastewater characteristic.*

CONDITIONS: Given references and a list of the advanced wastewater treatment processes.

ACCEPTABLE PERFORMANCE: The student will:

Select the references.

Describe the features of each advanced wastewater process unit which enable it to treat wastewater more efficiently than the conventional processes in the composite model plant.

INSTRUCTOR ACTIVITY:

1. Describe the references and how to use them.
2. Present a format for a table to compare the units in the composite model plant and the advanced treatment units.

STUDENT ACTIVITY:

1. Select the references and locate the information needed.
2. Prepare tables with the information.

<<<<<<>>>>>>

OBJECTIVE 6.2:	*Compare the water treatment processes and advanced wastewater treatment processes.*
CONDITIONS:	Given references and a list of the water treatment and advanced wastewater treatment plant processes.
ACCEPTABLE PERFORMANCE:	The student will: Select the references. Compare the water treatment and advanced wastewater treatment plant processes.
INSTRUCTOR ACTIVITY:	1. Describe the references and how to use them. 2. Present a format for a table to compare the water treatment and advanced wastewater treatment processes.
STUDENT ACTIVITY:	1. Select the references and locate each resource to find the information needed. 2. Prepare tables with the information.

<<<<<<>>>>>>